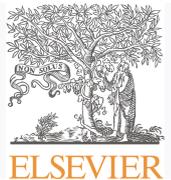




Developing social-ecological system indicators using group model building

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In many coastal regions, activities of multiple users present a growing strain on the ecological state of the area. The necessity of using integrative system approaches to understand and solve coastal problems has become obvious in the last decades. Integrated management strategies for social-ecological systems (SESSs) call for the development of SES indicators that help (i) to identify and link the states and processes of social, economic and ecological subsystems and (ii) to balance different stakeholder objectives over the long-term within natural limits. Here we use a system dynamics modeling approach called group model building (GMB) as a diagnostic participative tool for understanding the determinants of characteristic SES issues in the Dutch Wadden Sea region and exploring salient SES indicators for management. We used GMB in two separate workshops for two distinct cases: sustainable mussel fisheries and tourism development. Follow-up online questionnaires elicited relevant variables for deriving SES indicators. In both modeling cases participants identified and connected the variables that expressed fundamental SES dynamics driving each issue. In the mussel fisheries model the central part of the structure was the interaction between the model variables 'extent of mussel habitat with high natural value', 'mussel cultivation efficiency', and 'market supply'. In the tourism model a key driving force for explaining tourist development was the reciprocal relation between the model variables 'natural value', 'experience value', and 'number of tourists'. Application of GMB revealed SES issue complexity and explicitly identified key linkages and potential SES indicators for policy and management in the Dutch Wadden Sea area. As a tool for stakeholder involvement in integrated coastal management the approach enables the joint building of system understanding and the exchange of individual perspectives. Participants agreed with the jointly created models and highly appreciated the way the structured approach facilitated communication and learning about complex and contested issues.